EXPLANATION

UNCONSOLIDATED TO SEMI-CONSOLIDATED

QUATERNARY

af — **Artificial Fill**

Comprised of heterogeneous materials such as: rock, unconsolidated sediment, slag, refuse, and dredge spoil. Only major areas of filled or highly disturbed ground have been mapped, such as refilled pits, diked flood plains, and transportation corridors across topographically low areas.

Qal — **Alluvium** *

Interbedded gravel, sand, silt, and clay of variable composition and sorting. Typically confined to flood plains of perennial streams, upland gathering areas, and marshes adjacent to estuaries. Sediment size, sorting, and mineralogy are strongly controlled by the source rocks and geomorphic setting. The quartzose sands and polymict gravels are typically well-bedded and loosely-compacted; the silts and clays are often water saturated and poorly-bedded. Minor amounts of colluvium (unmapped) may interfinger with alluvium at or near the bases of slopes. Thickness 0.5 to 5 meters.

LATE TERTIARY-QUATERNARY(?)

Qtc — **Talbot Formation**

Buff to orange, poorly-sorted, poorly-bedded quartz silts with kaolinite, illite, and montmorillonite clays. Very sparse leaf and twig debris in bedded silts. This unit is very poorly exposed with mappable accumulations chiefly below the 40' contour. Depositional environment: alluvial flood plain or open marsh. Thickness 0.5 to 3 meters.

ug — **Upland Gravel**

Orange-brown, poorly-sorted, fine sand to boulders commonly floating in a clay-silt matrix. Ferruginous cementation along horizons of abrupt lateral and vertical sediment size changes. Deposits are well-bedded in places; fining-upwards sequences (1-3 meters) are rare. Sparse to abundant gravel and large blocks of fresh to weathered mafic crystalline rock are diagnostic framework components. Thickness 0.5 to 8 meters.

unconformity

LOWER CRETACEOUS — POTOMAC GROUP

Kps, Kpc — **Patapsco Formation**

Kpc — *Clay facies. Typically buff, red-yellow, and brown mottled kaolinitic clays. Variable amounts of quartz sand and silt as pods and interbeds or disseminated throughout the clay. Sideritic concretions and lignitized plant remains are rare. Laminated silt-clay couplets with plant debris in places. Deposited in oxidized flood plain-mud flat environment. Thickness 0.5 to 50 meters.*

Kps — *Sand facies. Well-sorted, medium to fine-grained quartz sand with locally abundant quartz gravel and clay clasts. Minimal clay-silt matrix. Sands are planar to high-angle crossbedded and in some outcrops show fining-upward sequences (3-5 meters thick). Ferruginous cements typically form ledges at sand-clay boundaries or as centimeter-size spheroids and pods within homogeneous sand. Tourmaline and zircon with minor staurolite and rutile constitute the heavy mineral suite. These sediments were deposited in and adjacent to channels of low gradient streams. Thickness 0.5 to 30 meters.*

Kac — **Arundel Formation**

Grey, brown, black, and red kaolinitic and illitic clays with locally interbedded quartz silt or sand lenses and pods. The clays are typically poorly-bedded to massive with occasional color mottling. Sparse to abundant irregular sideritic ledges or concretions and/or lignitized wood. Silts and clays contain sparse to abundant fern, cycadoid, and conifer debris as well as rare angiosperms. Lithologically similar but stratigraphically distinct from the Patuxent clay facies. Deposition occurred primarily within a flood plain-back swamp complex with variable sediment input. Thickness 0.5 to 10 meters.

Kxs, Kxc — **Patuxent Formation**

Kxs — *Sand facies. Highly variable, interbedded sand, gravel, silt, and clay containing ferruginous cements. Sand and gravel typically quartzose with a buff, kaolinitic clay-silt matrix. Sediments are organized into fining-upward packages (3-5 meters thick) consisting of planar-bedded gravel with clay clasts or cross-bedded sands at the base grading upward to laminated or massive silt-clay at the top. Elsewhere vertical sequences show abrupt sediment size changes and erosive contacts. The heavy mineral suite is characterized by staurolite, zircon, tourmaline, and kyanite. Sparse silicified and abundant iron-oxide replacements of both cycadoids and coniferous wood are present throughout the Formation. These sediments were deposited in a high-gradient, braided stream complex. Thickness 0.5 to 35 meters.*

Kxc — *Clay facies. Light gray to black or brown clay containing variable amounts of quartz silt and gravel; local concentrations of lignitic, partially pyritized wood or macerated leaf and cone debris are associated with some sideritic concretions. Thin planar beds of sand and/or gravelly clay are interbedded with massive clays. These isolated clay pods are thought to be accumulations on deflated surfaces such as abandoned stream channels or pre-Cretaceous topographic lows. Thickness 0.5 to 5 meters.*

unconformity

INTRUSIVE ROCKS — MESOZOIC

Diabase

A single occurrence of rusty-weathering, fine-grained, massive, black pyroxene-plagioclase rock as a dike less than 2 meters thick. Located along Gunpowder Falls 1,000 meters east of Bel Air Road.

SILURIAN

p — **Pegmatite**

Discrete, mappable bodies of massive, coarse-grained to very coarse-grained, light gray to pinkish rock composed of mica (mostly muscovite), quartz, albite, and microcline-perthite; minor garnet locally as crystals 2 millimeters in diameter. Similar pegmatites in the adjacent Towson quadrangle yield rubidium-strontium mineral ages of 425 million years.

Overprint. Areas in which other rock formations include up to 50% pegmatite, identical to that described above, as concordant masses a few meters thick. Commonly associated with or replaced by a finer grained gneissic rock of the same mineralogy.

cs — **Cold Spring Gneiss**

Fine- to medium-grained, uniform muscovite-biotite-microcline-plagioclase-quartz gneiss bearing microcline augen or subhedral megacrysts up to 5 millimeters in longest dimension. Age unknown.

CAMBRIAN

gl — **Gunpowder Gneiss**

Fine- to medium-grained, very uniform muscovite-biotite-microcline-plagioclase-quartz gneiss, locally bearing small microcline megacrysts, 2 to 4 millimeters in diameter. Concordia plot yields age of 450 million years.

Overprint. Areas in which the other rock formations include interlayered Gunpowder Gneiss, identical to that described above, as concordant sills, and rarely as cross-cutting dikes, as much as ten meters thick. Locally very muscovite rich along Honeygo Run.

top of crystalline stratigraphic section

CAMBRO-ORDOVICIAN(?)

p — **Perry Hall Gneiss**

Fine- to medium-grained biotite-quartz-plagioclase gneiss, locally muscovitic, and hornblende-quartz-plagioclase gneiss, commonly garnetiferous, with subordinate amphibolite, all interlayered on a scale of centimeters to tens-of-meters. Thin layers of quartzite at a few localities. Thickness indeterminate.

f — **Franklinville Gneiss**

Uniform, medium- to coarse-grained biotite-quartz-plagioclase gneiss, locally with muscovite. Quartz veins common. Near Franklinville, the Gneiss contains sparse, small inclusions of fine-grained, mica-rich biotite-quartz feldspar gneiss, and rare calc-silicate pods. Includes several zones up to 15 meters thick of deformed chlorite schist. Concordant layers of amphibolite and hornblende-quartz-plagioclase gneiss common near contact of underlying Bradshaw Layered Amphibolite. Equivalent to adjacent Port Deposit Gneiss of Harford County Geologic Map (1969). Thickness indeterminate.

CAMBRIAN(?) — BALTIMORE MAFIC COMPLEX

r (ns, s) — **Raspeburg Amphibolite**

Uniform, fine- to medium-grained amphibolite. Minor textural variations include coarse-grained, more massive amphibolite, and amphibolite bearing euhedral hornblende porphyroblasts up to 4 centimeters long. Outcrops are typically pitted due to the leaching of plagioclase. Thickness about 700 meters.

ns — *chlorite schist and talc-chlorite schist.*

s — *serpentinite, bluish-black, containing serpentine, amphibole, and chlorite.*

bl — **Bradshaw Layered Amphibolite**

Centimeter- to meter-scale interlayered amphibolite and hornblende-quartz-plagioclase gneiss with subordinate biotite-quartz-plagioclase gneiss. In some places includes zones several meters thick of coarse-grained, massive amphibolite, and in others, equally thick zones of fine- to medium-grained, laminated amphibolite. Quartzite and epidosite locally in thin layers. Stratigraphically equivalent to James Run Gneiss of Harford County Geologic Map (1969). Thickness about 900 meeters.

aac — *Poorly foliated to massive actinofels (actinolite rock).*

thrust fault

CAMBRO-ORDOVICIAN(?) — GLENARM SUPERGROUP — WISSAHICKON GROUP

sg, q, ea, m — **Oella Formation**

q — *Oella Formation. Medium-grained biiotite-plagioclase-muscovite-quartz schist, commonly garnetiferous, and in places bearing tourmaline, interlayered on a centimeter- to decimeter-scale with fine-grained biotite-plagioclase-quartz gneiss or fels. Ratio of schist to gneiss or fels commonly 2 to 1. Thickness 100 to 6000 meters.*

qs — *Sweathouse Amphibolite Member. Schist and gneiss or fels, indentical to that described under Oella Formation, interlayered with fine-grained, commonly laminated epidote amphibolite, generally on a scale of 5 to 10 meters. Thickness ranges from 0 to 2150 meters.*

ea — *epidote amphibolite*

a — *amphibolite*

lf (g-s, g, s), c, lh, lr, a — **Loch Raven Schist**

l — *Loch Raven Schist. Uniform, medium- to coarse-grained biotite-plagioclase-muscovite-quartz schist with lenses and pods of vein quartz. Locally biotite-rich and feldspathic. Quartzite very rare. Thickness ranges from 0 to 900 meters.*

(g) — *garnet facies. Garnet common; staurolite and kyanite rare or absent.*

(s) — *staurolite facies. Staurolite common; garnet and kyanite rare or absent.*

(g-s) — *garnet-staurolite facies. Garnet and staurolite common; kyanite rare or absent.*

lh — *Hydes Marble Member. Very poorly exposed, phlogopitic metalimestone; clean, massive, coarse-grained metalimestone; and fine- to medium-grained metadolostone. Thickness uncertain but probably no greater than 300 meters.*

c — *calc-silicate granofels. Massive rock composed chiefly of diopside plus quartz and tremolite.*

lr — *Rush Brook Member. Fine-grained, slabby weathering biotite-quartz-plagioclase gneiss and biotite-plagioclase-quartz gneiss, locally bearing muscovite, and subordinate, interlayered, fine- to medium-grained biotite-plagioclase-muscovite-quartz schist. Thickness ranges from 200 to 250 meters.*

a — *Amphibolite.*

cpl, cmd — **Cockeysville Marble**

cpl — *Phlogopitic metalimestone member. Fine- to medium-grained, millimeter- to centimeter-scale interlayered white to bluish-white calcite marble, and purplish, phlogopitic calcite marble or calc-schist with quartz, muscovite, scapolite, feldspar, and accessory diopside and tremolite. Locally uniformly silicate-rich or silicate-poor. Thickness ranges from 0 to 250 meters.*

cmd — *Massive metadolostone member. Medium-grained, snow-white, generally massive metadolostone consisting of over 95% dolomite plus minor diopside, tremolite, phlogopite, and quartz. Thickness ranges from 0 to 550 meters.*

s, sg, sq, sqs — **Setters Formation**

s — *Setters Formations undivided.*

sg — *Gneiss member. Fine-grained microcline-quartz gneiss with biotite, or biotite and muscovite, and conspicuous tourmaline. Includes subordinate quartzite in layers a few decimeters thick, and biotite-muscovite-microcline-quartz schist in zones up to several tens-of-meters thick. Thickness ranges from 0 to 150 meters.*

sq — *Quartzite member. Fine- to medium-grained, generally thin-layered (centimeter- to decimeter-scale) muscovite-microcline quartzite with subordinate, massive, clean, vitreous quartzite; accessory tourmaline and magnetite. Thickness ranges from 0 to 100 meters.*

sqs — *Schist lens. Medium-grained, biotite-microcline-quariz-muscovite schist, locally coarser and more feldspathic, rarely finer and more biotitic; sparse tourmaline. Quartzite layers a few decimeters thick common. Thickness ranges from 0 to 75 meters.*

unconformity

PRECAMBRIAN

pCba, pCbl — **Baltimore Gneiss**

pCba — *augen gneiss member. Pinkish fine- to medium-grained biotite-quartz-feldspar gneiss containing abundant, light-colored ovoids (augen) consisting of either feldspar (microcline) or feldspar and quartz. Interlayered on a scale of meters with fine- to medium-grained, uniform biotite-quartz-feldspar gneiss, and pinkish, coarse-grained, locally pegmatitic, biotite-quartz-feldspar gneiss. Thickness indeterminate. Dated radiometrically at 1,000 to 1,300 million years.*

pCbl — *layered gneiss member. Dark and light biotite-quartz-feldspar gneiss interlayered on a scale of centimeters to tens-of-meters; can vary from biotite schist to massive quartzo-feldspathic rock. Thickness indeterminate. Dated radiometrically at 1,000 to 1,300 million years.*

Radiometric ages from Higgins, 1972, G.S.A. Bull. V. 83, p. 1008-1012.

For the crystalline rocks, primary minerals are listed in order of increasing abundance. Grain size definitions are: fine = less than 1 mm; medium = 1-5 mm; coarse = 5mm - 3 cm; very coarse = greater than 3 cm.

For the crystalline rocks, stratigraphic units as opposed to purely lithologic units are indicated by partial or complete underscoring of the rock unit abbreviation. "Sg", for example, indicates the Setters Formation; "S" indicates serpentinite.

* *Structural symbols on alluvium represent bedrock exposures in stream valleys. These are typically either along the margins of the flood plain or close to the main channel of the drainage.*

contact — generally approximate or inferred. Distribution and concentration of structural symbols is an approximate measure of the reliability of any contact.

boundary between mineral facies of the Loch Raven Schist.

normal fault — U - upthrown side; D - downthrown side

thrust fault — teeth on upper plate

upright / overturned — axial trace of anticline or dome

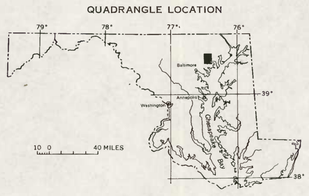
axial trace of overturned syncline

vertical / inclined / horizontal — foliation or schistosity (everywhere virtually parallel to compositional layering)

symmetric / dextrally asymmetric / sinistrally asymmetric / inclined / horizontal — axis and symmetry of minor fold

inclined / horizontal — mineral lineation

QUADRANGLE LOCATION



STATE OF MARYLAND
DEPARTMENT OF NATURAL RESOURCES
MARYLAND GEOLOGICAL SURVEY
Kenneth N. Weaver, Director

Copies of Atlas available from
Maryland Geological Survey
Johns Hopkins University
Baltimore, Maryland 21218

Base map from U. S. Geological Survey, 1951 (photorevised 1966) White Marsh Quadrangle
7½ Minute Series

Crystalline rocks mapped by W. P. Crowley, 1967-1969; sediments by J. Reinhardt and E. T. Cleaves, 1973-1974.

Map scribed by Margaret P. Ketchum.

Williams & Heintz Map Corporation, Washington, D. C. 20027

WHITE MARSH QUADRANGLE: GEOLOGY, HYDROLOGY AND MINERAL RESOURCES

MAP 1. GEOLOGIC MAP OF THE WHITE MARSH QUADRANGLE, MARYLAND

BY

William P. Crowley, Juergen Reinhardt and Emery T. Cleaves

1976

SCALE 1:24 000

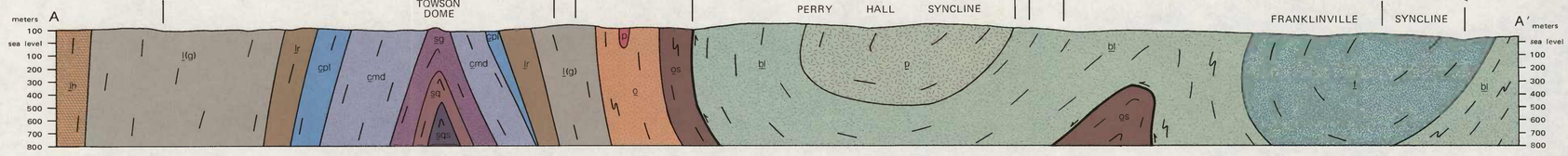
1 MILE 0 1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 KILOMETER 1 5 0

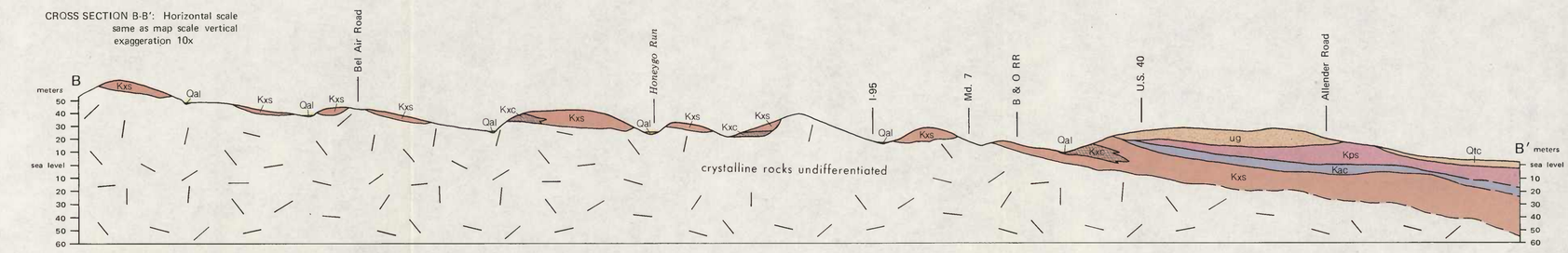
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

MN GN 8° 142 MILS 0°55' 16 MILS
UTM GRID AND 1966 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

CROSS SECTION A-A': Horizontal scale same as map scale, no vertical exaggeration. Discontinuous lines indicate trace of foliation.



CROSS SECTION B-B': Horizontal scale same as map scale vertical exaggeration 10x



EXPLANATION

The White Marsh Quadrangle lies mostly in the Piedmont Upland Section of the Piedmont Province (Fenneman, 1938, p. 131); the southeastern segment lies in the Embayed Section of the Coastal Plain Province (Thornbury, 1965, p. 36-38). The Piedmont Upland Section has been divided into Regions, Districts, Areas, and Zones following the scheme of Brown and Godfrey (unpublished ms.). In the White Marsh Quadrangle, I distinguish three regions, Fall Zone, Harford Plateaus and Gorges, and Phoenix Domes (Figure 1.). These Regions are divided into seven Districts. Figure 1 shows the relationship of the Regions and Districts in the Quadrangle to those elsewhere in Baltimore County.

Zones are defined mainly on morphometric criteria of slope and relief. However, the relative importance of geomorphic processes differs from zone to zone; and characteristics such as overburden thickness vary depending upon the geomorphic process and the rock lithology. The Zone is the basic unit from which Map 3, Estimated Thickness of Overburden, and Map 4, Geologic Factors Affecting Land Modification were compiled. Figure 2 illustrates some of the landforms and their relationship to rock lithology and overburden thickness.

Because the Quadrangle Map is the initial publication using this classification in Maryland, the designation of unit names and boundaries are subject to modification and will be defined and discussed in a subsequent publication. The physiographic map units are coded as follows: Region -upper case letter, District -lower case letter; Area (as necessary) -second lower case letter; zone -numeral. For example, the symbol Hbh2 means Zone 2 of the Hydes Valley Area of the Bel Air Upland District of the Harford Plateaus and Gorges Region.

Piedmont Province

Piedmont Upland Section

Fall Zone Region

The Fall Zone Region constitutes an area of transition between those regions of the Piedmont Upland Section underlain by crystalline rocks and the Coastal Plain Province underlain by unconsolidated to semi-consolidated sediments. Most upland areas and ridges of the Fall Zone are capped by unconsolidated sediments which thicken southeastward towards the Coastal Plain Province. Major rivers and streams flow across the Region in steep walled valleys incised into crystalline rock. In general, I have drawn the Fall Zone-Coastal Plain boundary based upon the last southeastward occurrence of crystalline rock and saprolite. These points of last occurrence are connected by following landform boundaries of Zones (e.g., Fp4, Em4) or are arbitrarily connected where local physiographic criteria are lacking. In a similar manner, I have drawn the Fall Zone boundary with adjacent Regions of the Piedmont Upland Section at the last northwestward occurrence of pre-Holocene sediments. Minor outliers of sediments have been ignored. Where the Gunpowder Gorge District of the Harford Plateaus and Gorges Region approximately parallels the Fall Zone, the regional boundary has been drawn along the southeastern side of the gorge. The Fall Zone Region in the White Marsh Quadrangle is subdivided into the Gunpowder Gorge and Perry Hall Upland Districts.

Fg — Gunpowder Gorge District

The Gunpowder Gorge District is characterized by the occurrence of low steep slopes (Zone Fg3.). Local relief reaches 200 feet at U.S. No. 1 and Gunpowder Falls. Gunpowder Falls and major tributary streams are deeply incised into the crystalline bedrock. The boundary between the District and adjacent ones is generally defined by the local topographic divides on ridges and hills immediately adjacent to and generally paralleling the river and includes the watersheds of gullies and "first order" intermittent streams which empty directly into the river.

Fg1 Floodplains, boggy areas, and headward extension of channels which may carry water during heavy rains. Fluvial processes dominant. Bedrock at or near surface (<5 feet) except where buried beneath alluvial deposits. Bouldery to silty sand alluvium 15 feet or more thick occurs along Gunpowder Falls.

Fg2 High, very steep slope. Relief up to 160 feet. Slope generally greater than 12°, and exceeds 20° in places. Occurs only in one place, adjacent to boundary with District Hg. Mass movement processes dominate.

Fg3 Low steep slopes. Relief 60 to 160 feet. Slopes generally greater than 12°. Rock outcrops and large boulders common. Mass movement processes dominant, and mantle instability may occur if slope is disturbed.

Fg4 Side slopes and divides of limited areal extent. Moderate slopes generally between 6° to 12°. Relief 40 to 160 feet. Mass movement and chemical weathering are active processes in modifying the landscape. Sedimentary deposits occur on some Fg4 segments.

Fg5 Not present in quadrangle.

Fg6 Divides with less relief than Fg4. Slopes generally less than 6°, and relief 20 to 80 feet. Sediments cap many Fg6 segments.

Fg7 Gently rolling to flat upland surfaces. Slopes generally less than 6°. Relief 20 to 60 feet. Sediments cap most of the Fg7 segments.

Fp — Perry Hall Upland District

The Perry Hall Upland District is characterized by rolling uplands and ridges most of which are capped by sediments (Zones Fp4, Fp6, Fp7). Streams generally have eroded through the sediment cap and are cutting into the underlying saprolite and bedrock. Two residual hills north of White Marsh rise up through the sediment and expose crystalline rock. Little Gunpowder Falls flows across the District in a valley incised into bedrock and characterized by moderate slopes (Fp4) and low steep slopes (Fp3) with local relief of 60 to 100 feet. Contrarywise streams which originate in the District flow across it in broad shallow valleys, the valleys becoming narrower and valley sides steeper as they near the Coastal Plain or the Gunpowder Gorge District.

Fp1 Floodplains, boggy areas, and headward extension of channels which may carry water during heavy rains. Stream valleys are broader and bordered by gentler slopes than in Zone Hb1 (Bel Air District) or Zone Pc1 (Chattolanee District). Bedrock at or near surface (<5 feet) where streams flow on crystalline rock terrain. Along Little Gunpowder Falls, alluvial deposits 15 feet or more thick may occur. Fluvial processes dominant.

Fp2 Not present in this quadrangle.

Fp3 Low steep slopes. Relief 60 to 100 feet. Slopes generally exceed 12°. Rock outcrops and boulders common. Mass movement processes dominant, and mantle may become unstable if slope is disturbed.

Fp4 Side slopes and divides of limited areal extent. Relief 60 to 140 feet. Moderate slopes (6° to 12°) generally underlain by sediments; north of Gunpowder Falls segments generally underlain by saprolite. Mass movement and chemical weathering processes modify the landscape.

Fp5 Floodplains, boggy areas, and headward extensions of channels that may carry water during heavy rains. Alluvial deposits and colluvial material of low density 1 to 10 plus feet thick may be present. Sediments underlie part or all of many Fp5 segments. Fluvial processes dominant.

Fp6 Divides with less relief and more broadly spaced draws than Zone Fp4, and side slopes between Zones Fp5 and Fp7. Slopes generally less than 6°; locally 6° to 12°. Relief 40 to 120 feet. Sediments underlie part or all of most Fp6 segments.

Fp7 Gently rolling to flat upland surfaces with broadly spaced draws and streams. Slopes generally less than 6°, locally between 6 to 12°. Relief 20 to 60 feet. Sediments underlie part or all of most Fp7 segments.

Harford Plateaus and Gorges Region

The Harford Plateaus and Gorges Region occupies most of the northern part of the Quadrangle, and is divided into the Gunpowder Gorge District and Bel Air Upland District. In the Quadrangle and throughout Baltimore County, the region is characterized by rolling uplands interrupted by gorge-like steep walled valleys.

At the Region and District level physiography is independent of rock lithology and structure. For example the gorge-like valleys of Gunpowder Falls District are physiographic features unaffected by the geology. However, within the Bel Air and Hampstead Upland Districts, distinctive landforms at the Area level of classification are related to the occurrence of serpentinite (Soldiers Delight Area) and marble (Caves Valley and Hydes Valley) (Figure 1). A part of the Hydes Valley Area occupies the northwestern corner of the White Marsh Quadrangle.

Hg — Gunpowder Gorge District

In the Quadrangle, Gunpowder Falls and its major tributary streams are deeply incised into bedrock. The District is dominated by high steep slopes (Zone Fg2.). Local relief varies from 160 to 280 feet. The boundaries of the District are defined like those of the Gunpowder Falls Gorge District in the Fall Zone Region.

Hg1 Floodplains, boggy areas, and headward extension of channels which may carry water during heavy rains. Fluvial processes dominant. Bedrock at or near surface (<5 feet) except where alluvial deposits are present. Bouldery to silty sand alluvial deposits 15 feet or more thick occur along Gunpowder Falls.

Hg2 High, very steep slopes. Relief up to 200 feet. Slopes generally exceed 12° and commonly exceed 20°. Rock outcrops, rock slabs, and large boulders common. Mass movement processes dominant, and mantle instability may occur if slope is disturbed.

Hg3 Low, steep slopes. Relief 60 to 160 feet. Slopes generally exceed 12°. Rock outcrops and large boulders common. Mass movement processes dominant, and mantle instability may occur if slope is disturbed.

Hg4 Side slopes and divides of limited areal extent. Relief 40 to 160 feet. Moderate slopes generally between 6° to 12°. Mass movement and chemical weathering processes affect landscape.

Hg5 Floodplains, boggy areas, and headward extension of channels which may carry water during heavy rains. Alluvial and colluvial material of low density, one to 10+ feet thick, may be present. Fluvial processes dominate.

Hg6 Divides with less relief than Hg4. Slopes generally less than 6°. Relief 20 to 100 feet. Chemical weathering processes dominant.

Hg7 Gently rolling to flat upland surfaces. Slopes generally less than 6°. Relief 20 to 60 feet. Chemical weathering processes dominant.

Hb — Bel Air Upland District

The Bel Air Upland District in the White Marsh Quadrangle is characterized by rolling uplands and a marble valley. Solutional weathering combined with fluvial erosion of the Hydes Marble Member of the Loch Raven Schist has resulted in a distinctive broad lowland herein termed the Hydes Valley Area. The lowland is underlain by the Hydes Marble and the surrounding hills by the Loch Raven Schist.

The uplands of the Bel Air District are underlain by Loch Raven Schist north and west of the trend of Sweathouse Branch, and a line extended through the towns of Fork and Reckord. To the south and east the uplands are underlain mainly by mafic rocks of the Perry Hall Gneiss and Bradshaw Layered Amphibolite. The mafic rock terrain is less intricately dissected by stream erosion than the felsic schist terrain. And the saprolite on the mafic rock has numerous corestones in contrast to the very micaceous saprolite of the felsic schist. Because these contrasts are not obvious in the landforms, I have not divided these segments of the District into Areas. Subsequent work in adjacent quadrangles may demonstrate that these criteria are sufficient to define and map separate Areas.

The upland is incised by the fluvial erosion of streams such as Little Gunpowder Falls which flows in a steep-walled valley across the northeastern part of the Quadrangle. Other major streams in the Quadrangle are deeply incised in their lower courses and open out upstream into broad shallow valleys.

Hb1 Floodplains, boggy areas, and headward extension of channels which may carry water during heavy rains. Fluvial processes dominant. Streams flow in narrower valleys bordered by steeper slopes than in Zone Fp1 of the Perry Hall District. Bedrock at or near surface (<5 feet) except where buried beneath alluvial deposits. Alluvial deposits may exceed 15 feet along major streams.

Hb2 Terrace-like surface of low relief adjacent to Hb1. Flooding infrequent, generally only in events of high intensity and low frequency. Alluvial deposits may be 15 feet or more thick.

Hb3 High, very steep slopes. Relief up to 240 feet. Slopes generally exceed 12°, and commonly exceed 20°. Rock outcrops, rock slabs, and large boulders common. Mass movement processes dominant, and mantle instability may occur if slope is disturbed. Hb3 segments occur along Little Gunpowder Falls.

Hb4 Low, steep slopes. Relief 60 to 140 feet. Slopes generally exceed 12°. Rock outcrops and large boulders common. Mass movement processes dominant, and mantle instability may occur if slope is disturbed.

Hb5 Side slopes and divides of limited areal extent. Relief 40 to 180 feet. Moderate slopes generally between 6° to 12°. Mass movement and chemical weathering are dominant processes. Where underlain by mafic rocks, residual boulders present in saprolite.

Hb6 Floodplains, boggy areas, and headward extension of channels which may carry water during heavy rains. Alluvial and colluvial deposits of low density, one to 10+ feet thick, may be present. Fluvial processes dominant.

Hb7 Divides with less relief and more broadly spaced draws than Zone Hb4, rolling upland terrain and side slopes extending from Zone Hb6 to Hb8. Slopes generally less than 6°, locally 6° to 12°. Relief 40 to 100 feet. Chemical weathering processes dominant. Where underlain by mafic rocks, residual boulders present in saprolite.

Hb8 Gently rolling to flat upland surfaces. Slopes generally less than 6°. Relief 20 to 60 feet. Chemical weathering processes dominant. Where underlain by mafic rocks, residual boulders present in saprolite.

Hbh — Hydes Valley Area

The Hydes Valley Area is the only Area recognized in the Bel Air Upland District at this time.

Hbh1 Floodplain. Underlain by fine to medium grained alluvium 2 to 15+ feet thick. Fluvial processes dominant.

Hbh2 Low to intermediate slopes between water courses. Slopes generally less than 6°. Relief 20 to 40 feet. Broad, open terrain. Underlain by marble which weathers to a residuum characterized by abrupt local changes in thickness, residual boulders, and rock pinnacles.

Phoenix Domes Region

The Phoenix Domes Region occupies a small part of the White Marsh Quadrangle located north of Gunpowder Falls in the vicinity of Glen Arm. The boundary of the Region with the Harford Plateaus and Gorges Region is approximately the contact between the Loch Raven Schist and Cockeysville Marble. Along the southeast side of the Region, the Cockeysville Marble pinches out, and the topographic distinction disappears. Where the valley disappears, the boundary between the two Regions is arbitrarily drawn at the geologic contact between the Loch Raven Schist and either the Baltimore Gneiss, Setters Formation, or Gunpowder Gneiss.

The Phoenix Domes Region is characterized by a distinctive wide, flat bottomed valley which is floored by Cockeysville Marble and a rolling upland underlain mainly by Baltimore Gneiss. A steep slope, underlain by Setters Formation, separates upland from lowland. The dome-like geological and physiographic aspect of the Region results from the juxtaposition of Cockeysville Marble and Setters Formation and the much greater susceptibility of the marble to chemical weathering compared to the Setters Formation. In addition to the Timonium Valley and Chattolanee Upland Districts which characterize most of the Region, the Gunpowder Gorge District is recognized where that stream has cut a narrow defile through the Upland.

Pg — Gunpowder Gorge District

The characteristics and boundaries are like those described for the District in the Harford Plateaus and Gorges Region. The District occurs in a very small area just north of Gunpowder Falls along the west margin of the Quadrangle, and the only zones present are Pg1, Pg3, Pg4, and Pg6.

Pg1. Same description as that for Hg1

Pg3. Same description as that for Hg3

Pg4. Same description as that for Hg4

Pg6. Same description as that for Hg6

Pt — Timonium Valley District

The Timonium Valley District is underlain by the Cockeysville Marble. The boundary of the District with the Chattolanee Upland approximately follows the geologic contact between the Cockeysville Marble and Setters Formation. In the Timonium Valley the local relief is 20 to 60 feet, and the slope of most of the land is less than 6 degrees.

Pt1 Floodplains, boggy areas, and headward extensions of channels which may carry water during heavy rains. Fluvial processes dominant. Underlain by fine to medium grained alluvium 2 to 15+ feet thick.

Pt2 Bedrock terraces, with short steep slopes facing streams and flat surfaces extending back towards valley sides. Above area of flooding. Overburden thickness generally less than 5 feet, and residuum characterized by rock pinnacles and residual boulders.

Pt3 Low to intermediate slopes between water courses and adjacent valley sides. Relief 20 to 40 feet. Slopes generally less than 6°. Underlain by marble. Chemical weathering dominant. Numerous pinnacles and residual boulders in residuum. Overburden thickness extremely variable.

Pc — Chattolanee Upland District

The Chattolanee Upland District has two components, low steep slopes (Zone Pc3) underlain by Setters Formation, and a gently rolling to subdued hilly terrain underlain mainly by Baltimore Gneiss. Relief along Zone Pc3 varies from 80 to 160 feet, and slope commonly exceeds 12 degrees. On the upland, local relief varies from 40 to 100 feet; slopes locally approach 12 degrees, but generally are less than 6 degrees. Long Green Creek flows through the District in a steep-walled valley and, like the valley of Little Gunpowder Falls in the Bel Air and Perry Hall Districts, is considered as part of the district rather than a separate district.

Pc1 Floodplains, boggy areas, and headward extension of channels which may carry water during heavy rains. Fluvial processes dominant. Bedrock at or near surface (<5 feet) except where buried beneath alluvial deposits. Alluvial deposits generally 5 feet or less thick, and very bouldery along Long Green Creek.

Pc2 Not present in quadrangle.

Pc3 Low, steep slopes. Relief 80 to 160 feet. Rock outcrops, rock slabs, and large boulders common. Slopes generally exceed 12°. Mass movement processes dominant, and mantle instability may occur if slope is disturbed.

Pc4 Side slopes and divides of limited areal extent. Relief 40 to 120 feet. Moderate slopes generally between 6° to 12°. Mass movement and chemical weathering processes dominant.

Pc5 Floodplains, boggy areas, and headward extension of channels which may carry water during heavy rains. Fluvial processes dominant. Alluvial and colluvial deposits of low density, one to 10+ feet thick, may be present.

Pc6 Divides with less relief than Pc4 and rolling upland terrain. Relief 20 to 100 feet. Slopes generally less than 6°, locally 6° to 12°. Chemical weathering processes dominant.

Pc7 Not present in quadrangle.

Coastal Plain Province

Embayed Section

Em — Middle River Estuary District

The Embayed Section of the Coastal Plain Province occupies the southeastern corner of the Quadrangle. The Section is underlain by unconsolidated to semiconsolidated sediments unlike the adjacent Piedmont Upland Section of the Piedmont Province which is underlain by crystalline rocks. Regions and Districts have not yet been designated for the Embayed Section. However, for this map the designation Middle River Estuary District is adopted. The name comes from an estuary in the adjacent Middle River Quadrangle. This designation is temporary and may be changed when additional physiographic mapping is done in the Coastal Plain of Maryland.

Em1 Broad to narrow floodplains, boggy areas, and headward extension of channels that may carry water during heavy rains. The floodplains of the Bird River and Gunpowder Falls include extensive marshes and swamps.

Em2 Low lying marshes and swamps adjacent to Bird River and Gunpowder Falls. Slopes less than 3°. Relief less than 10 feet.

Em3 Flat, low lying surfaces adjacent to Bird River and Gunpowder Falls. Relief less than 20 feet.

Em4 Low slopes on broad open terrain. Slopes less than 6°, and commonly less than 3°. Relief less than 20 feet.

Em5 Side slopes and divides of limited areal extent. Moderate slopes generally between 6° to 12°. Relief 40 to 120 feet.

Em6 Rolling upland with broadly spaced draws. Relief 20 to 60 feet. Slopes generally less than 6°, locally 6° to 12°.

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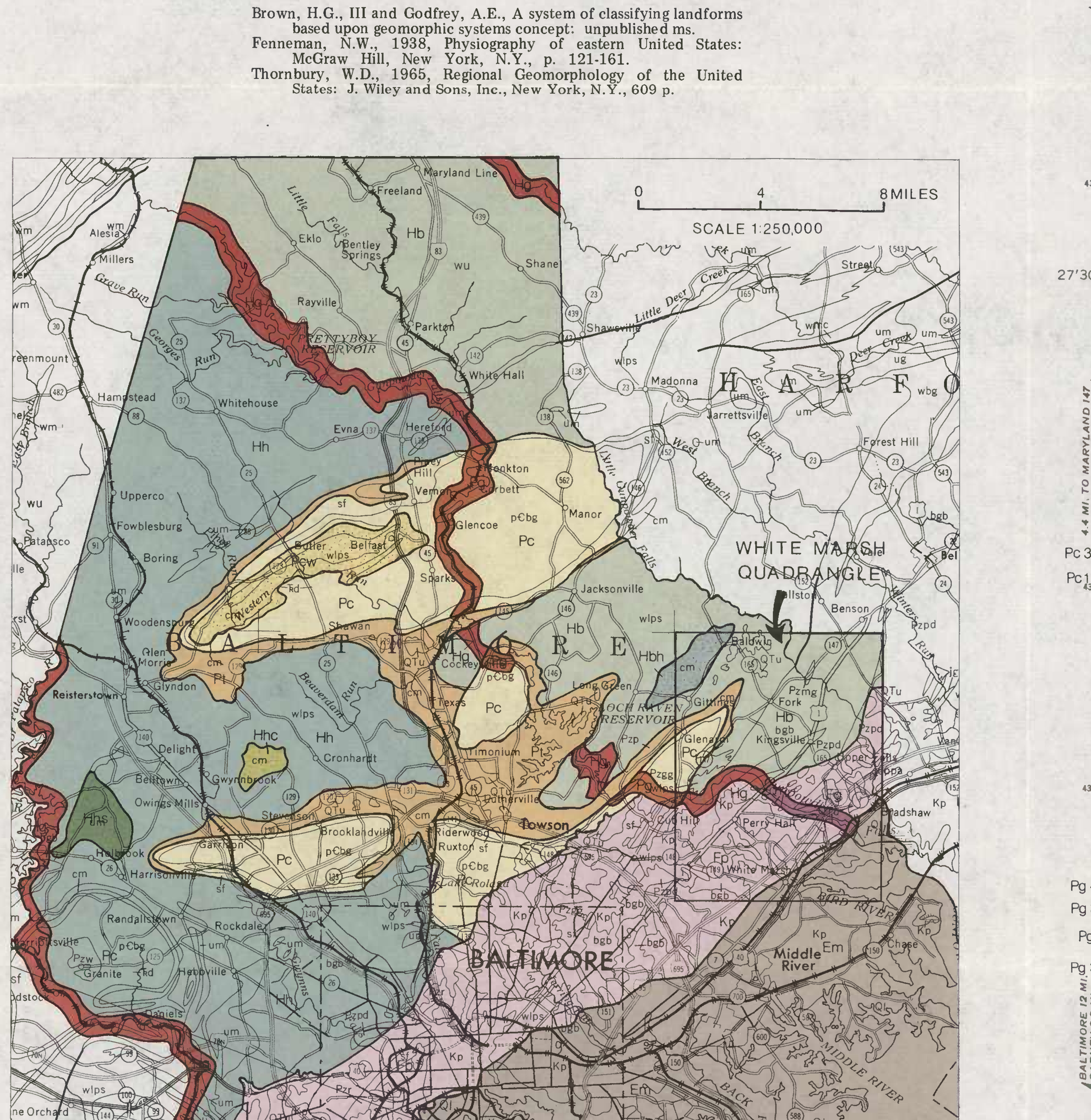


Figure 1. Physiographic Map of Baltimore County.

Piedmont Province
Piedmont Upland Section

Fall Zone Region		Harford Plateaus and Gorges Region	
Fp	Perry Hall Upland District	Hb	Bel Air Upland District
Fg	Gunpowder Gorge District	Hbh	Hydes Valley Area
Phoenix Domes Region		Hg	Gunpowder Gorge District
Pc	Chattolanee Upland District	Hh	Hampstead Upland District
Pcw	Western Run Area	Hhc	Caves Valley Area
Pt	Timonium Valley District	Hhs	Soldiers Delight Area
Pg	Gunpowder Gorge District		

Coastal Plain Province
Embayed Section

Em — Middle River Estuary District

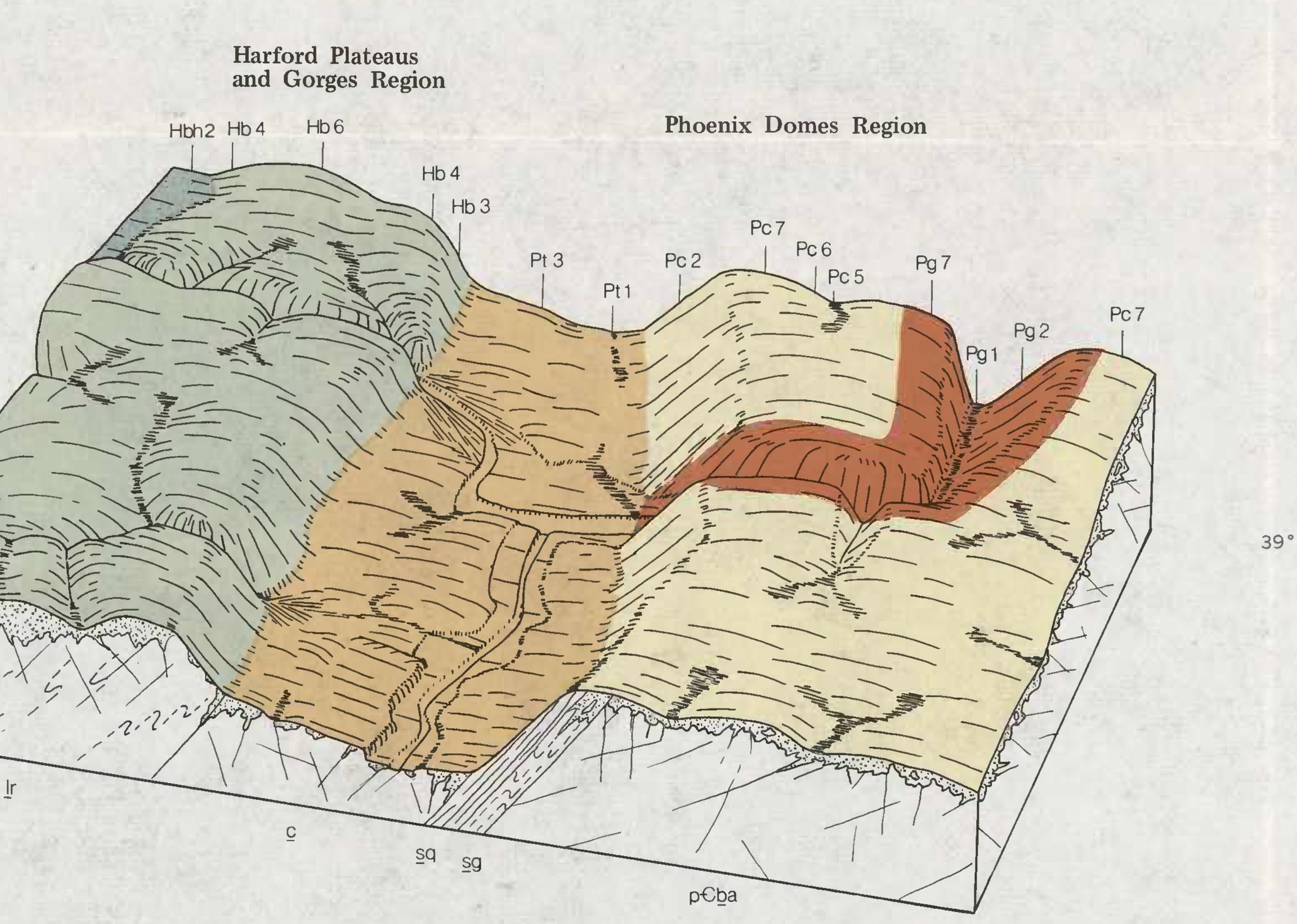
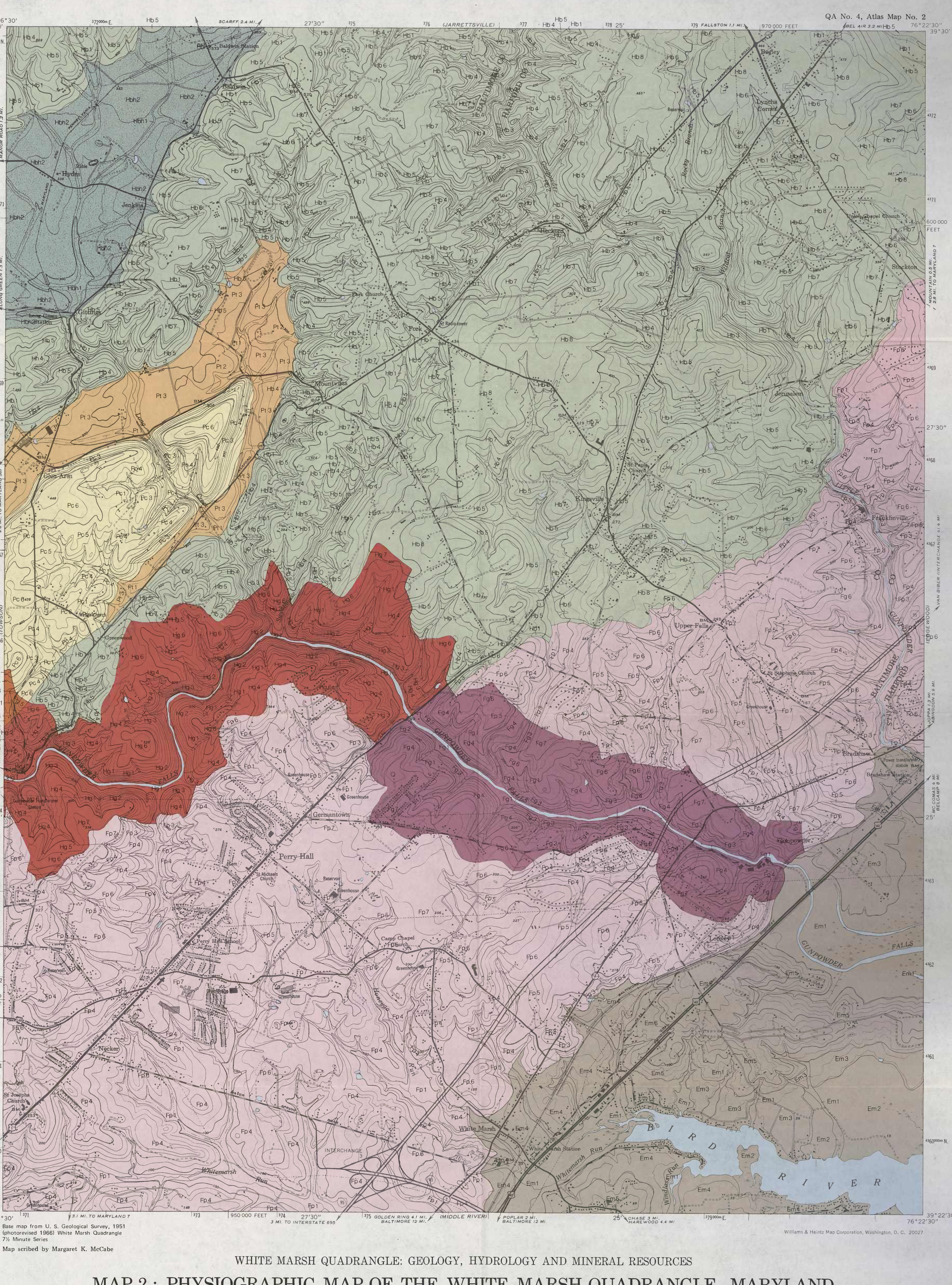


Figure 2. Block Diagram Illustrating Physiographic Units and Their Relationship to Lithology and Overburden

Physiographic regions and symbols for Districts, Areas, and Zones are shown across top of diagram. The units are defined in the text. Geologic units shown across bottom of diagram are: lr-Loch Raven Schist; cm-Cockeysville Marble; sq-Setters Formation, quartzite member; sq-Setters formation, gneiss member; b-Baltimore Gneiss, augen gneiss member. Stipple pattern represents saprolite.

The thickness of the saprolite is directly related to rock lithology and zone. Regardless of bedrock lithology, overburden is usually 0 to 5 feet on units Hb3, Pc2, Pg2 (low to high steep slopes). On Loch Raven Schist, overburden thickness is estimated at 5 to 20 feet on Zone Hb4, and exceeds 20 feet on Zone Hb6 and Hbh2. On Cockeysville Marble, on Zone Pt3 overburden thickness is extremely variable, and the residuum contains numerous residual boulders (corestones). On the augen gneiss member of the Baltimore Gneiss, the saprolite contains corestones, and generally is 5 to 20 thick on Zones Pc6, Pc7, and Pg7. The relatively thin bouldery saprolite on Pc6 contrasts to saprolite thickness commonly in excess of 20 feet mantling Loch Raven Schist on Zone Hb6.

QA No. 4, Atlas Map No. 2



Base map from U. S. Geological Survey, 1951 (photorevised 1966) White Marsh Quadrangle 7½ Minute Series
Map scribed by Margaret K. McCabe
Williams & Heintz Map Corporation, Washington, D. C. 20027

WHITE MARSH QUADRANGLE: GEOLOGY, HYDROLOGY AND MINERAL RESOURCES

MAP 2 : PHYSIOGRAPHIC MAP OF THE WHITE MARSH QUADRANGLE, MARYLAND

By
Emery T. Cleaves
1979

QUADRANGLE LOCATION

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

STATE OF MARYLAND
DEPARTMENT OF NATURAL RESOURCES
MARYLAND GEOLOGICAL SURVEY
Kenneth N. Weaver, Director

Copies of Atlas available from
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Johns Hopkins University
Baltimore, Maryland 21218

UTM GRID AND 1966 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

INTRODUCTION

This map is both an inventory of past and present mineral operations and a survey of potential mineral resources in the White Marsh Quadrangle. Currently, sand and gravel is the only resource being utilized as well as being the most extensively worked resource in the Quadrangle. There are five active pits, two of which have processing facilities on site. The Description of Operations in each case refers to active sites, and includes the pit name, mineral producers name, and operational status.

Potential mineral resources within the Quadrangle include building stone, crushed stone, clay, sand, and gravel. Although not all of the mineral resources shown on the map have been worked within the Quadrangle, their utilization elsewhere has justified their consideration as a potential mineral resource for the White Marsh area. Other resources that have been worked in the past, but which are no longer of economic importance are the pegmatites for feldspar, marble for lime and the Potomac Group sediments for iron ore. Historically, extraction of iron ore was the primary mineral industry in the area. Five iron ore furnaces and/or forges were established between 1743 and 1820. All were shut down in the area by the time of the Civil War. Their probable locations are shown on the map.

In all, over 930 acres have been disturbed by the mining industry for local, commercial, or industrial uses. Approximately 21% of this area is currently being worked or used for plant and storage sites. This figure may include some areas that are currently in the process of being reclaimed. About 59% of the disturbed land has been reclaimed, and includes areas that have been graded, planted, developed or otherwise utilized. The remaining 20% represents acreage that has not been reclaimed and is not being worked at present. However, these figures do not reflect small operations whose dimensions and exact locations have been obliterated through time. The following chart gives a status report on disturbed land:

Inactive and Abandoned Acreage	Reclaimed Acreage	Working Acreage	Total Acreage Disturbed
185.6	546.9	197.6	930.1

The information presented here was compiled from literature research and field investigations (1973-1978). Aerial photographs were used to help delineate the extent and location of the operations [Department of Agriculture, 1:20,000 photographs (1938, 1943, 1947, 1952, 1953, 1964, 1971), U.S. Geological Survey photographs (1966) and Photo Science, Inc. (1978)]. Special thanks are given to the late Dr. William P. Crowley, Dr. Jonathan Edwards, Jr. of the Maryland Geological Survey, and Mr. Roland E. Manger of the Flintkote Stone Products Company for the information and assistance they provided and to Mr. Brien J. Partika for his help in the field.

PRESENT AND POTENTIAL RESOURCES

Sand and Gravel: Economic deposits of sand and gravel are found in the Patuxent sand facies (Kxs)*, and in the Upland Gravels (ug). The Upland Gravels reach a maximum thickness of 8 meters and consist of fine sand to boulders with gravel predominant. This deposit has not been worked as extensively as the sand facies of the Patuxent Formation. Sand and gravel has been extracted from the Patuxent Formation in the White Marsh Quadrangle for over 55 years. The unit consists of interbedded sand, gravel, silt and clay. Although primarily sand and gravel, the interbedded silt and clay results in a variability that can only be ascertained by on-site investigations. There are currently two operations active in the Patuxent Formation and two working in the Upland Gravels.

Variable Sand and Gravel: Into this category fall two units: the Patapsco sand facies (Kps), and the alluvial deposits (Qal) found at the mouths of Gunpowder Falls and White Marsh Run. The probability of finding economic deposits within these units is not as high as in the Patuxent Formation or the Upland Gravels. The sand facies of the Patapsco is primarily sand with locally abundant gravel ranging in thickness from .5 to 30 meters. Outcrops of this unit are not extensive in this Quadrangle, but the Patapsco is currently being worked in the Days Cove area. The alluvial deposits consist of interbedded sand, gravel to cobbles, silt and clay. Economic deposits of sand and gravel may be present in some places. These areas are within the flood plain and excavation may involve additional considerations. Further upstream, the alluvium along White Marsh Run has been extensively mined. The Bradshaw Pit (see Description of Operations) is currently working in the alluvium along Gunpowder Falls. There is a new operation by the same company to excavate the alluvium on the opposite side of the Falls.

Clay: The Arundel Formation (Kac) consists of a grey, black or red clay with minor sand lenses. Its thickness ranges from .5 to 10 meters. It has been used extensively in the past for bricks, pipes, tiles and common pottery as well as providing a source of paint ochre. Although not currently being worked in the Quadrangle operations in the Arundel Formation elsewhere for brick and structural clay products suggest a similar utility here.

Gneiss and Amphibolite: The gneissic and amphibolitic rocks present in the Quadrangle may offer a potential source of crushed stone for roads, construction, fill and local use. These rock units are: the gneiss member of the Setters Formation (sg), Bradshaw Layered Amphibolite (bl), Raspeburg Amphibolite (r), Franklinville Gneiss (f), Perry Hall Gneiss (p) and the Gunpowder Gneiss (gg). The rocks are massive, and have been worked either in the Quadrangle or elsewhere for crushed stone or building stone. The economic potential of the rocks may vary depending on the depth of overburden, accessibility, and the exact chemical and physical quality of the material at any given site.

Marble: Two bodies of marble in the Quadrangle may provide a source of crushed stone. These are the phlogopitic metalimestone member (cpl) and the massive metadolostone member (cmd) of the Cockeysville Marble and the Hydes Marble Member (lh) of the Loch Raven Schist. Historically, both of the marble groups were quarried in the Quadrangle for lime for local agricultural needs as well as to provide a good stone for local building purposes. The Cockeysville Marble is currently being quarried in other areas for crushed stone and pure calcite, and was at one time a primary source for building stone. Both marble sources may have varying amounts of dolomite present which would preclude its use in cement. The amount of overburden may effect the economic potential of the marble, but this can only be determined from on-site investigations.

Quartzite: Quartzite in the Setters Formation (sq) has long been known to provide a good stone for general building purposes, or flagstone. The quartzite is hard, resists weathering, and has joints and fractures that yield a roughly rectangular construction block. The Setters quartzite is currently being quarried in Baltimore County but has not been worked to date within the Quadrangle.

HISTORICAL MINERAL RESOURCES

Pegmatite: The mappable bodies of pegmatite (p) found in the Quadrangle consist of massive, coarse grained rocks composed primarily of mica, quartz and feldspar. These rocks have been quarried for the potash-rich feldspar. It was utilized for poultry grit, binding in emery and corundum wheels, and in ceramics. Sites where the feldspar was loosened by weathering were the most profitable to work. The pegmatite has also been used for local crushed stone needs. The bodies of pegmatite in the Quadrangle are small and, therefore, unlikely to be quarried in competition with large scale operations.

Iron ores: There are 11 known iron ore operations in the Quadrangle. The iron ore was generally found in concretionary form in the Potomac group sediments. Excavation of the ore was accomplished by either open cut methods, or tunneling and gouging where the overburden was too great. On the surface, very little evidence of the old workings remain.

* For the boundaries and more information on this and all other specific geological deposits mentioned, please refer to map I of this atlas.

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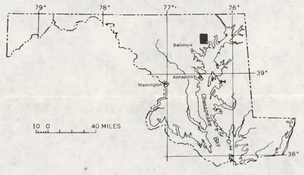
DESCRIPTION OF OPERATIONS

1 White Marsh Plant; Flintkote Stone Products Company; portions of area graded, planted or developed.
2 Schwartz Pit; Rockville Crushed Stone Corp; working.
3 Allender Road Pit; Flintkote Stone Products Company; portions graded and planted.
4 Smuck Pit; Flintkote Stone Products Company; working.
5 Bradshaw Pit; Flintkote Stone Products Company; working.
6 Day's Cove Pit; Flintkote Stone Products Company; working.

MAP SYMBOLS

- ●1 Working operation, see Description of Operations
- ▲ Reclaimed operation
- Abandoned or inactive sand and gravel pit
- Abandoned or inactive quarry
  - a — amphibolite
  - gn — gneiss
  - m — marble
  - fs — feldspar
- Probable site of former iron ore operations
- Probable site of former iron ore forge/furnace
- Boundary of larger operation
- sand and gravel
- variable sand and gravel
- clay
- gneiss and amphibolite
- marble
- quartzite
- pegmatite

QUADRANGLE LOCATION



Base map from U. S. Geological Survey, 1951 (photorevised 1966) White Marsh Quadrangle 7½ Minute Series

Map drafted by Margaret K. McCabe

WHITE MARSH QUADRANGLE: GEOLOGY, HYDROLOGY AND MINERAL RESOURCES

MAP 3 : MINERAL RESOURCES AND MINED LAND INVENTORY

By

Karen R. Kuff

1979

STATE OF MARYLAND
DEPARTMENT OF NATURAL RESOURCES
MARYLAND GEOLOGICAL SURVEY
Kenneth N. Weaver, Director

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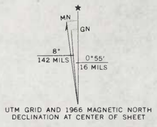
SCALE 1:24000

1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETER

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL



UTM GRID AND 1966 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Williams & Heintz Map Corporation, Washington, D. C. 20027

QUADRANGLE ATLAS NO. 4

WHITE MARSH QUADRANGLE: GEOLOGY, HYDROLOGY, AND MINERAL RESOURCES

By

Emery T. Cleaves, Karen R. Kuff, Edmond G. Otton,
William P. Crowley and Juergen Reinhardt

1979

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